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Quality of Water from Test Wells in the Castolon area, Big Bend National Park, Brewster County, Texas

By Jack Rawson

GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

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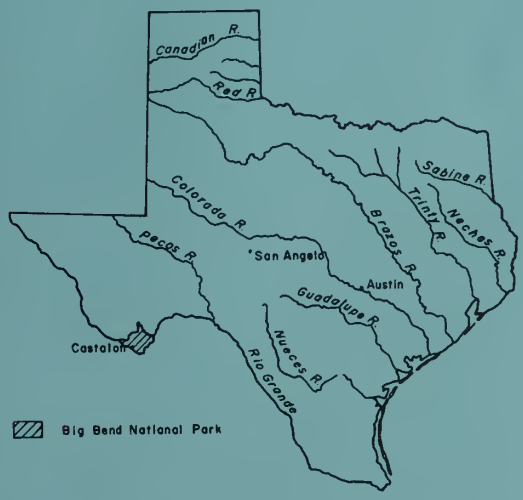

Prepared for the National Park Service

Open File Report - October 1963

RECV'D. W/REG. MEMO 12/23/63

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Quality of Water from Test Wells in the Castolon Area, Big Bend National Park, Brewster County, Texas

By
Jack Rawson

Prepared for the National Park Service
United States Department of the Interior
August 1963

Austin, Texas

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QUALITY OF WATER FROM TEST WELLS IN THE CASTOLON AREA, BIG BEND NATIONAL PARK, BREWSTER COUNTY, TEXAS

By Jack Rawson

INTRODUCTION

In response to a request of the National Park Service, a reconnaissance of the water resources of the Castolon area, Big Bend National Park, Tex. (fig. 1), was made by the U.S. Geological Survey during the period Nov. 26 - Dec. 8, 1962. The purpose of the investigation was to determine the most promising source of water for a proposed campground and ranger station at Castolon (Leggat, 1963). The Park Service estimated that the proposed campground would require 10,000 gpd (gallons per day) initially, or about 7 gpm (gallons per minute), and possibly as much as 20,000 gpd, or 14 gpm, when the campground is developed. As a result of the reconnaissance, the Geological Survey recommended that test well or wells be drilled in the alluvium of Blue Creek to determine the physical properties, extent, and thickness of the alluvium as well as the quality of the water at several depth intervals. The alluvial deposits in the drainage basin of Alamo Creek were also considered as a potential source of water for the campground should results of test drilling in the channel of Blue Creek indicate that the quantity of water of good quality in the alluvium is not sufficient to satisfy the needs of the campground.

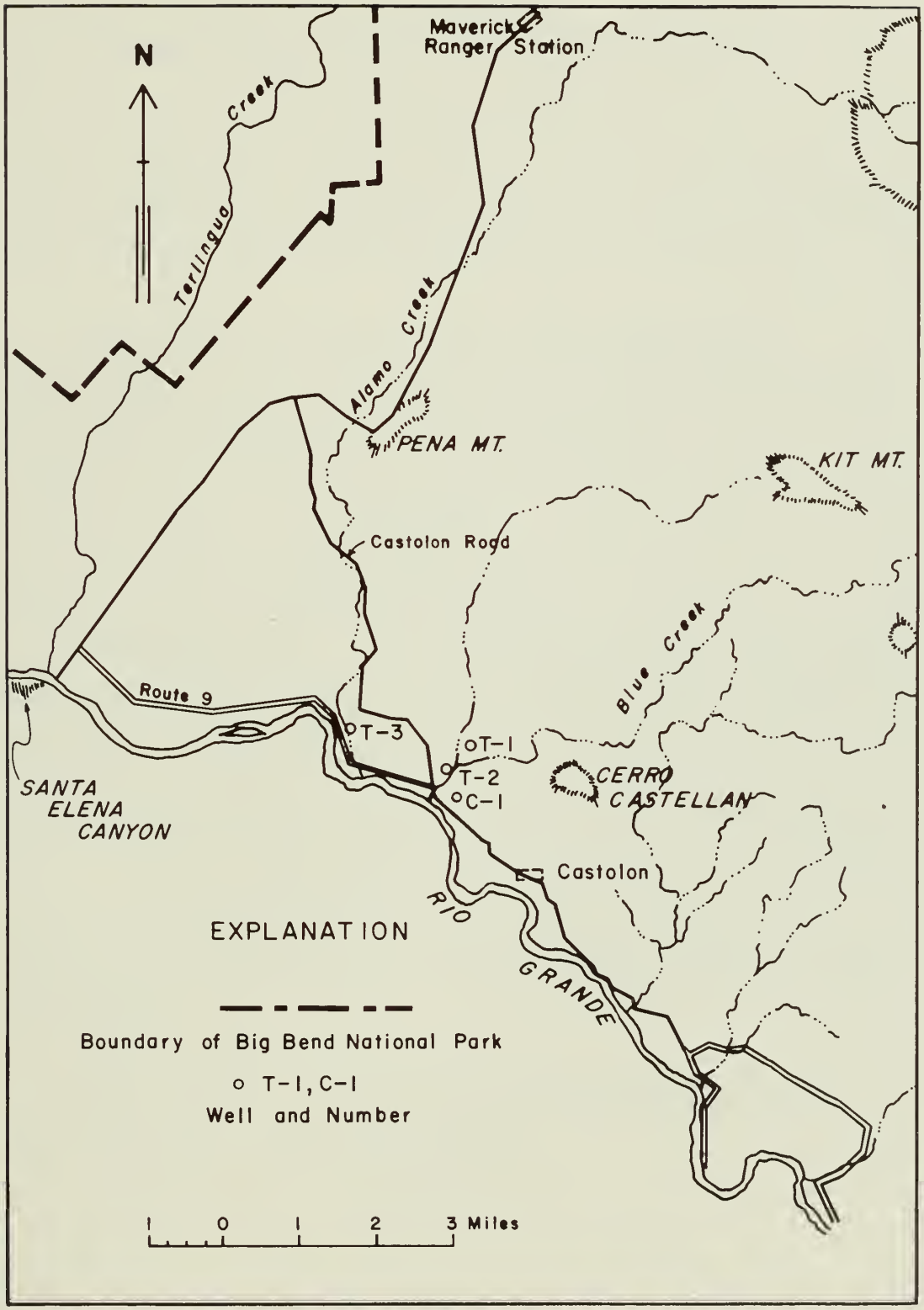

FIGURE 1.—Map of Castolon area, Big Bend National Park, Brewster County, Tex.

Drilling of test wells in the Castolon area was begun in July 1963. The author went to Castolon to analyze and evaluate the quality of water encountered during the drilling of the test wells and to furnish guidance in the drilling. This report gives an evaluation of the quality of water from the test wells in the Castolon area.

Appreciation is expressed to Mr. Stanley Joseph, Park Superintendent, and to other members of the Park Service for their cooperation in supplying data on the test wells.

TEST WELLS

Castolon Test Well 1

Castolon Test Well 1 (T-1) was drilled along Blue Creek, 2,417 feet north of Castolon Road near the confluence of Blue Creek and an unnamed tributary that heads in the Kit Mountains (see fig. 1). The well log is given in table 1. Water was first encountered at a depth of 200 feet. The results of a chemical analysis of a sample of water from the well showed that the water contained 778 ppm (parts per million) chloride, 26 ppm total hardness, and less than 5 ppm sulfate.

Between depths of 210-215 feet oil was encountered, and the well was plugged, capped, and abandoned.

Table 1.--Logs of test wells in the Castolon area, Big Bend National Park, Brewster County, Texas

Castolon Test Well 1

Driller: C. Langlitz

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Silt	3	3	Clay, gray, with trace of gray shale	5	145
Sand	25	28	Shale, gray	15	160
Sand, fine-grained	9	37	Clay, gray, shaly	10	170
Sand, with clay	3	40	Clay, gray	5	175
Clay, yellow, with some gray	5	45	Clay, gray, sandy	5	180
Clay, grayish-yellow	5	50	Clay, greenish-gray, sandy	10	190
Clay, blue, silty	10	60	Sand, greenish-gray, argillaceous	5	195
Clay, blue	10	70	Sand, greenish-gray, with some clay	5	200
Clay, brownish-gray	5	75	Sandstone, greenish-gray	10	210
Clay, brownish-gray, containing very fine gravel	5	80	Sand, greenish-gray, argillaceous	5	215
Clay, gray, slight brown tint	5	85			
Clay, reddish-brown	35	120			
Clay, grayish-brown	15	135			
Clay, gray, slight brown tint	5	140			

Castolon Test Well 2

Driller: C. Langlitz

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Sand and gravel	20	20	Clay, brownish-gray	5	45
Sand and gravel, silty	5	25	Clay, brown	5	50
Sand and gravel	15	40	Clay, grayish-brown	10	60

Castolon Test Well 3

Driller: C. Langlitz

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
Silt, light brown	10	10	Clay, reddish-brown	5	55
Sand and gravel	36	46	Clay, yellowish-gray	10	65
Clay, grayish-brown	4	50	Clay, reddish-brown	4	69

Castolon Test Well 2

Castolon Test Well 2 (T-2) was drilled in the alluvium of Blue Creek, 907 feet north of Castolon Road (fig. 1). The well log (table 2) showed that the thickness of the alluvial deposits was about 40 feet. The driller reported that water was first encountered at a depth of 25 feet. However, the static water level was 17.5 feet, and no artesian effects were noted; therefore, water was probably encountered at a depth of 17.5 feet. Samples of water for chemical analysis were collected at depths of 25, 47, and 60 feet. Results of specific conductance determinations and of chemical analyses made in the field for selected chemical constituents are given in table 2. The chemical analysis of water from the 25-foot level was not altogether representative, due to contamination by river water used in drilling. However, the analysis indicated that the water was suitable for the public supply of the proposed campground at Castolon.

Approximate determinations of yields were made by bailing, and the initial test at the 25-foot level indicated a yield of about 1 gpm. At the 60-foot level a yield of not more than 3 gpm was achieved during preliminary bailing tests. A chemical analysis of the water (table 1) showed that the water was suitable for the public supply of the proposed campground.

Table 2.--Field analyses of water from test wells in the Castolon area, Big Bend National Park, Brewster County, Texas

(Results in parts per million except as indicated)

Well	Depth (feet)	Date of collection	Sulfate (SO_4)	Chloride (Cl)	Hardness as $CaCO_3$	1/Specific conductance (micromhos at 25°C)
U.S. Public Health Service Drinking Water Standards			250	250		
T-1	200	July 11, 1963	<5	778	26	2,300
2/T-2	25	July 13	228	33	60	900
T-2	47	July 14	68	10	16	450
T-2	60	July 16	54	7.0	36	410
T-3	46	July 17	338	14	124	1,020
T-3	68	July 19 (7:00 a.m.)	364	13	96	1,100
T-3	68	July 19 (6:30 p.m.)	316	13	128	1,090

1/ Field conductivity instrument was later found to have been operating improperly. Results shown are believed to be about 200 micromhos too low.

2/ Sample possibly contaminated by river water used in drilling.

Upon completion of the bore to a depth of 60 feet, 6-inch casing, which was torch slotted from 15 to 45 feet, was installed. After the well was gravel-packed and cleaned out the estimated yield was 13-14 gpm. Pumping tests were made to determine the well's capacity and drawdown. The following description of the pumping tests is from a narrative statement of Castolon test-well data obtained from Coleman C. Newman, acting Park Superintendent (written communication, October 1962).

> "The pump used was a 1 H.P. "Reda", Model 12B, and the pump inlet was positioned at 51 feet. During the maximum yield test, the well was pumped to 100% drawdown and the yield varied linearly with the time from 15 G.P.M. to 13.6 G.P.M. The "maximum yield" test was stopped after six hours and the well was allowed to recover. The recovery was rather rapid, rising from 100% drawdown (water level = 51 feet) to 2.2% drawdown within eleven minutes. Within an hour and a half the well had recovered the original static water level of 17.5 feet. The "desired yield" test was then started. Due to an error in calculation, the first hour of this test was conducted to obtain a yield of 7.7 G.P.M. After an initial drawdown to 1.9 feet or 6.9% the drawdown increased gradually so that at the end of the first hour the dynamic water level was 19.8 feet, giving a drawdown of 2.3 feet or 8.4%. The yield was then increased to 10.3 G.P.M. This resulted in an immediate drop in the dynamic water level to 20.2 feet, giving a drawdown of 2.7 feet or 9.8%. Thereafter the dynamic water level dropped very slowly, and after eleven hours of continuous pumping it stood at 21.9 feet, giving a drawdown of 4.4 feet or 16%. For the next hour, experimentation was performed to determine if a greater sustained yield could be obtained without an extreme drawdown. The yield was increased to 12.5 G.P.M. (an increase of 21.4%); however, the dynamic water level dropped to 32.3 feet (a drawdown increase of 47.4%). These figures indicated that the optimum yield of the well had been exceeded so the yield was cut back to 10.3 G.P.M. The dynamic water level recovered to its earlier level (21.9 feet) in 38 minutes."

Samples of water for chemical analyses were collected periodically during the first six hours of the pumping test. Results of analyses of samples of water collected during the pumping test are given in table 3. The results indicate that the water is generally suitable for public supply, although the fluoride content exceeds the limit recommended by the U.S. Public Health Service (1962).

Castolon Test Well 3

Castolon Test Well 3 (T-3) was drilled in the alluvium of Alamo Creek, 796 feet north of Route 9 (fig. 1). The well log (table 2) showed that the thickness of the alluvial deposits was about 40 feet. The driller reported that water was first encountered at a depth of 46 feet. However, the static water level was 32.3 feet, and no artesian effects were noted; therefore, water was probably encountered at a depth of 32.3 feet. Samples of water for chemical analysis were collected at depths of 46 and 68 feet. Results of specific conductance determinations and chemical analyses made in the field for selected chemical constituents are given in table 1. These results indicated that the water was suitable for public supply, although the sulfate content exceeded the limit recommended by the U.S. Public Health Service.

Table 3.--Chemical analyses of water from wells in the Castolon area, Big Bend National Park, Brewster County, Texas

(Results in parts per million except as indicated)

Well	Depth of well (feet)	Date of collection	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (calculated)	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Specific conductance (micromhos at 25°C)	pH
U.S. Public Health Service Drinking Water Standards			--	0.3	0.05	--	--	--		--	250	250	a1.0	45	500	--	--	--	--	--
T-2	60	July 23, 1963	21	--	--	7.5	0.9	143		328	41	6.0	4.2	1.2	386	22	93	13	583	7.6
T-2	60	do.	56	--	--	5.8	.4	145		340	33	4.5	4.2	1.2	417	16	95	16	588	7.6
T-2	60	do.	57	--	--	5.8	.4	147		344	33	4.5	4.2	1.2	422	16	95	16	592	7.5
T-2	60	do.	57	--	--	5.8	.4	145		340	33	4.5	4.2	1.2	418	16	95	16	595	7.5
T-2	60	do.	57	.06	.01	5.8	.4	143	1.1	340	33	4.5	4.2	1.2	417	16	95	16	595	7.5
T-3	68	July 24	55	--	--	48	2.9	262		390	336	12	3.4	6.5	918	132	81	9.9	1,270	7.4
T-3	68	do.	56	--	--	42	3.6	264		402	324	10	3.8	2.8	904	120	83	10	1,250	7.4
T-3	68	do.	57	--	--	42	3.6	264		404	324	10	3.8	2.8	906	120	83	10	1,250	7.4
T-3	68	do.	56	.03	.00	42	3.6	260	.6	402	324	10	3.8	2.8	901	120	82	10	1,230	7.4
C-1	68	Dec. 6, 1962	--	--	--	--	--	--		261	402	122	--	--	--	390	--	--	1,490	6.9

a Based on annual mean maximum temperature at El Paso, Tex.

Upon completion of the bore to a depth of 69 feet, 6-inch casing, which was torch slotted from 25.5 to 47.4 feet,was installed. After the well was gravel-packed and cleaned out, a bailing test indicated a yield of more than 38 gpm. Pumping tests were made to determine the well's capacity and drawdown. The following description of the pumping test is from a narrative statement of Castolon test-well data obtained from Coleman C. Newman, acting Park Superintendent (written communication, Oct. 1962).

> "For test purposes the pump inlet was positioned at 48.5 feet below ground level. At the start of the pump test the static water level was at 32.3 feet. After pumping for six hours, at a maximum rate (33.3 G.P.M.) the dynamic water level was 37.6 feet, giving a drawdown of 4.3 feet or 28.5%. For the next hour of pumping, the discharge was held at 30 G.P.M. and it was found that the dynamic water level remained constant at 36.2 feet, giving a drawdown of 3.9 feet or 25.8%."

Samples of water for chemical analysis were collected periodically during the pumping test. Results of analyses of samples of water collected during the pumping tests are given in table 3. The results indicate that the sulfate, fluoride, and dissolved-solids content of the water exceed the limits recommended by the U.S. Public Health Service. However, the concentrations of these chemical constituents are not excessively high and do not preclude the use of the water for the proposed campground at Castolon.

CONCLUSIONS AND RECOMMENDATIONS

Water from Well T-2 is of good quality and meets the U.S. Public Health Service Drinking Water Standards with respect to sulfate, chloride, nitrate, dissolved solids, iron, and manganese.

Water from Well T-3 does not meet the drinking water standards with respect to fluoride, sulfate, and dissolved solids. The sulfate and dissolved-solids content of the water are not excessive, and the water could be used for the purpose intended.

The fluoride concentrations in water from both wells exceed the limit recommended by the U.S. Public Health Service and can be expected to cause mottled enamel in teeth of children who drink the water over an extended period of time. Local residents with children should use bottled water or other low-fluoride water for drinking purposes.

The results of the investigation indicate that the water of good quality supplied by Well T-2 will be of sufficient quantity to satisfy the initial needs of the proposed campground.

Should water requirements for the campground exceed the capacity of well T-2, the water supply could possibly be supplemented by drilling other wells in the alluvium of Blue Creek. If this does not prove feasible, the need for additional water could be met by mixing the waters from T-2 and T-3. A mixture of equal volumes of water from the two wells would contain about 660 ppm dissolved solids and about 185 ppm sulfate, and would be suitable for use at the campground.

Another alternative would be a mixture of water from well T-2 with that from well C-1. Well C-1, about 1,300 feet east of the channel of Blue Creek (fig. 1) was drilled to a depth of 101 feet in October 1962 to supply water for a contractor's field camp (Leggat, 1963). During a 35-minute test the well was pumped at 20 gpm. Results of a chemical analysis of water from well C-1 (table 3) show that the water is of poorer quality than water from wells T-2 and T-3. However, a mixture of equal volumes of water from well C-1 and T-2 should result in water that is satisfactory for public supply.

REFERENCES

U.S. Public Health Service, 1962, Public Health Service drinking water standards: Public Health Service Pub. No. 956, 61 p.

Leggat, E. R., 1963, Water supply for the Castolon area, Big Bend National Park, Brewster County, Texas: U.S. Geological Survey open file report, 19 p.